Abstract No. flyn393

Evidence for the Origin of Organic Matter in the Solar System

G.J. Flynn (SUNY, Plattsburgh) and L.P. Keller (NASA Johnson Space Center),

Beamline(s): U10B

Introduction: The origin of the organic matter in interplanetary materials has not been established. A variety of mechanisms have been proposed, with two extreme cases being a Fisher-Tropsch type process operating in the gas phase of the solar nebula or a Miller-Urey type process, which requires interaction with an aqueous fluid, presumably occurring on an asteroid. In the Fisher-Tropsch case, we might expect similar organic matter in hydrated and anhydrous interplanetary materials. However, aqueous alteration is required in the case of the Miller-Urey process, and we would expect to see organic matter preferentially in interplanetary materials that exhibit evidence of aqueous activity, such as the presence of hydrated silicates. The types and abundance of organic matter in meteorites have been used as an indicator of the origin of organic matter in the Solar System. However, all anhydrous carbonaceous chondrite meteorites are significantly depleted in the moderately volatile elements compared to the “solar” composition. The high temperature (>1200 C) proposed to explain the volatile depletion is sufficient to remove or destroy most volatile organic matter in the anhydrous meteorites, *indicating that the meteorite studies do not constrain the origin of organic matter.*

Methods and Materials: Many anhydrous interplanetary dust particles (IDPs), dust from comets and asteroids collected by NASA aircraft from the Earth’s stratosphere, have volatile contents higher than the hydrated carbonaceous meteorites, suggesting these IDPs experienced minimal thermal processing. Unequilibrated mineralogy and high D/H spots within micrometers of regions with normal D/H further demonstrate that many IDPs never experienced significant heating. We employed the micro-FTIR instrument at U10B to characterize the carbon in anhydrous IDPs, hydrated IDPs, and hydrated meteorites. The silicates, sulfides, oxides, and carbonates interfere with the detection of organic absorption features over much of the 400 to 4000 cm-1 range analyzed, but the C-H stretching region near 3000 cm-1 is free of other absorptions. Thus we have focused our efforts on this region.

In addition, we estimated the concentration of aliphatic hydrocarbon in each sample by comparing the strength of the C-H absorption features to the strength of the silicate absorption feature in each IDP and in reference samples we prepared as mixtures of known amounts of aliphatic hydrocarbon in silicate glass.

Results: Eight IDPs exhibited FTIR spectra significantly different from the silicone oil in which they are collected and from the terrestrial control particles. The strongest absorption in the 3 micron region in each of these 8 particles is at 2926 cm^{-1}, and a second, weaker, feature at 2854 cm^{-1} was also detected. This pair of absorptions is characteristic of $C\text{-}H_2$ symmetric and asymmetric stretching vibrations of aliphatic hydrocarbons. A weaker absorption was detected at 2960 cm^{-1}, a $C\text{-}H_3$ stretching vibration at a position slightly different from the silicone oil feature. Comparison with the reference samples indicated that the IDPs contained percent-level concentrations of aliphatic hydrocarbon.

Conclusions: The high (percent-level) abundance of aliphatic hydrocarbons in anhydropus IDPs and the similarity of the C-H stretching absorptions in anhydrous IDPs, hydrated IDPs, and hydrated carbonaceous meteorites are *consistent with the production of much of the organic matter prior to incorporation into the asteroids*

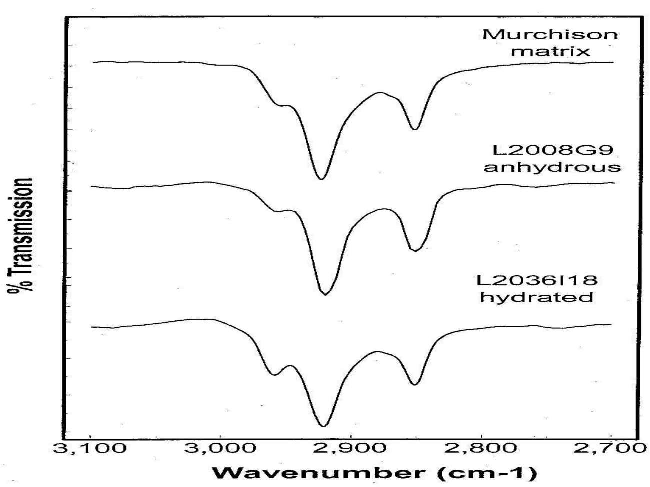

Figure 1: FTIR spectra over the C-H stretching region of the Murchison meteorite, an anhydrous IDP, and a hydrated IDP.